

# DEEP-SEA FISH LEECHES (RHYNCHOBDELLAE: PISCICOLIDAE)

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The small collection of fish leeches (Rhynchobdellae: Piscicolidae) reported in this study was taken by the *Galathea* Expedition 1950-1952.

The collection is of special interest for two reasons: the depths from which the specimens came and the large size of one of the species. Three of the lots were made at depths of 3570 to 4400 m, two others at 290 and 610 m. The greatest reported depths of which we are aware for marine and freshwater leeches are, respectively 582 m (MOORE & MEYER, 1951: 23) and 1000 m (DOGIEL & BOGOLEPOVA, 1957: 447). The length of *Galatheabdella bruuni* n.sp. described below, qualifies it along with *Carcinobdella kanibir* Oka, 1910 (which Soós [1965: 441] has synonymized with *Notostomobdella cyclostoma* [Johansson, 1898]), *N. laeve* (Levinsen, 1882), and some species of *Pontobdella* as the largest of Piscicolidae leeches. Only two of the leeches in the collection were accompanied by host data. Evidently the other specimens left their hosts during ascent to the surface in the trawl or after the mass of animals and debris was emptied on the ship's deck and awaiting examination, as usually happens. We are grateful for the kindness of Dr. TORBEN WOLFF for referring the material to us.

The material is kept in the Zoological Museum, Copenhagen.

## *Bdellamaris eptatrei* Richardson, 1953

(Fig. 1 a-f)

### Material

St. 616, Milford Sound (44°37'S, 167°53'E), 290 m, 19 Jan. 52, gear: 3 m sledge trawl, bottom temp.: 11.5°C. - 4 specimens: 12.5 mm, 20.0 mm, 22.0 mm, and 1 sectioned (frontal, anterior end; transverse, posterior end).

St. 626, Tasman Sea (42°10'S, 170°10'E), 610 m, 20 Jan. 52, 3 m sledge trawl - 4 specimens: 25.1 mm; 34.5 mm, collapsed along the venter; 31.0

mm, from *Myxine* (dissected); 28.0 mm (mounted).

This species was known previously from the vicinity of Cook Strait, with a probable record from off Timaru, associated with and ectoparasitic on the hagfish, *Eptatretus cirrhatus* Bloch & Schneider, 1801. Not more than 25 specimens were seen. These ranged in length from 29.0 mm to 35.0 mm, and the species was described from selected, well-extended specimens in excellent condition.

Not one of the *Galathea* specimens can be completely described in intimate detail for full comparison with the original account. The somital annulation of this species is complex and difficult to determine because of the absence of recognizable intersomital furrows and external landmarks, other than the pulsatile vesicles on the post-genital somites. In the entire specimens, all but two have prominent male and female everts, the exceptions have only the male evert. Because of this, the morphological relationship of the gonopores cannot be determined.

The large specimens have an external resemblance to *B. eptatrei* as previously known. The smallest specimen differs from this. The body is almost cylindroid throughout its length, and the posterior sucker is relatively much larger. Only the existence of a series enables the recognition of the smallest specimen as *B. eptatrei*. In this series, the urosome becomes progressively depressed with increase in length, and the posterior sucker, relatively smaller. This increase in the relative width of the urosome compared with the diameter of the posterior sucker, as the specimen increases in length, has been reported by SAWYER (1970) for *Oceanobdella blennii* (Knight-Jones, 1940), and is known to occur in other species of Piscicolidae.

*Bdellamaris eptatrei* as known (RICHARDSON, 1953) is of moderate size; white in colour, lacking

dark pigment and pattern; elongate, subcylindrical anterior to the gonopores, depressed, narrow with obtusely rounded margins posterior to these pores, and these two regions of the body separated more by change in section than by definite shoulders; both regions, closely annulate; 11 pairs of external pulsatile vesicles, the 1st pair on XIII; the ventral body wall thin along the urosome, and six pairs of testes and some somital ganglia visible through this; anterior sucker, of a width equal to the maximum width of the following region, lacking eye spots and interannular grooves; posterior sucker, lacking ocelli is about 1-1/3rd the maximum width of the posterior region.

Somites V and VI, 3-annulate; VII through XI, 2-annulate, with VIII and IX secondarily 4-annulate below; XII, 2-annulate, secondarily 5-annulate; XIII through XXIII, 6-annulate with each annulus divided (i.e. 12-annulate) and each of these somites with a single pair of external pulsatile vesicles; XXIV, 10-annulate; XXV, 2-annulate, secondarily 4-annulate; XXVI, complete and XXVII incomplete 2-annulate; anus at XXVI/XXVII.

Mouth-pore, subcentral in the sucker; proboscis, simple, cylindrical, terminating at VIII/IX or just within IX; crop, extending from IX to XIX/XX (in error, ending XVIII/XIX, RICHARDSON [1953: 289]), with poorly defined simple compartments in XIII through XV, and more distinctly defined compartments each with lobed lateral pouches in XVI through XIX; no postcaeca; intestine, compartmented, the compartments in XX to XXII, each with a single pair of large anteriorly directed lateral pouches on the anterior half of each compartment, an asymmetrical compartment with a caecum in XXIII; a small symmetrical pouched compartment of the rectum in XXIV, the rectum then wide, with four of five pairs of lateral pouches, the anterior pair large, the following pairs diminishing in size.

The male gonopore in the middle of XII; the female gonopore, at XII/XIII or immediately adjacent to this. A male evert was seen in only one specimen. None showed a female evert.

Six pairs of elongate oval testes at XIX/XVIII through XIV/XIII, the anterior pair, distinctly small; vas deferens, dorsal above the testes, terminating at XII/XIII, then increasing slightly in diameter as a small poorly formed short seminal vesicle, folding loosely as a narrower epididymis in XII and connecting terminally at XI/XII to the dorsal procurrent limb of the wider tubular atrial cornu, each cornu reflecting in VIII or IX as a recurrent limb

joining the anterodorsal aspect of the large simple male atrium; large partly folded saccular ovaries in XV connecting by thin-walled oviducts to the large thin-walled female atrium. The pars prostatica is extensive.

None of the previous specimens exhibited a clitellum of the usual form, i.e., a thickening of the body wall on all aspects from X through XIII, nor is there such a clitellum in the *Galathea* specimens. In all which have been examined, a thick layer of large gland cells is present internal to the muscular layers of the body wall, from about XXIII through XI. The layer extends across the dorsum, down each side, so that these aspects are opaque, but is lacking from the ventral body wall excepting for small clusters of cells in the vicinity of the somital ganglia. The cells of this layer are drained by columns of aggregated ducts which terminate on the venter in the vicinity of the genital pores. These cells were recognized as clitellar gland cells.

A cocoon is not yet known for *B. eptatreti*. The manner in which the ducts open on the venter resembles the condition described by NAGAO (1958) for *Glossiphonia lata* Oka, 1910, which forms the usual Glossiphoniidae brood sac, and not a cocoon. The morphology of this gland system in *B. eptatreti* seems unsuitable for the formation of a cocoon typical of the Piscicolidae, and suggests that this species may form a structure more like a brood sac, attaching it to the surface in the manner of species of *Glossiphonia*, *Placobdella*, etc. (SAWYER, 1971), but not brooding the young.

A modified area surrounding the gonopores and extending posteriorly onto XIV, was recognized as a "copulatory area" in the original account; but no conductive tissue was then seen. The presence of both male and female everts in the *Galathea* specimens, along with the termination of the gland cell ducts in this vicinity, indicate this area as modified to provide for protrusion of the everts, for glandular secretion; and accordingly doubtfully a modification for copulation.

#### *Galathea* material

In the following, the 31.0 mm specimen, tube (b), St. 626, labelled as taken "On *Myxine*" is assignable to *B. eptatreti* on external and internal evidence, and this specimen is detailed first. With this identification as a basis, it is then possible to describe the other specimens and detail such evidence as correlates them with this same species.

The general external features of the 31.0 mm spe-

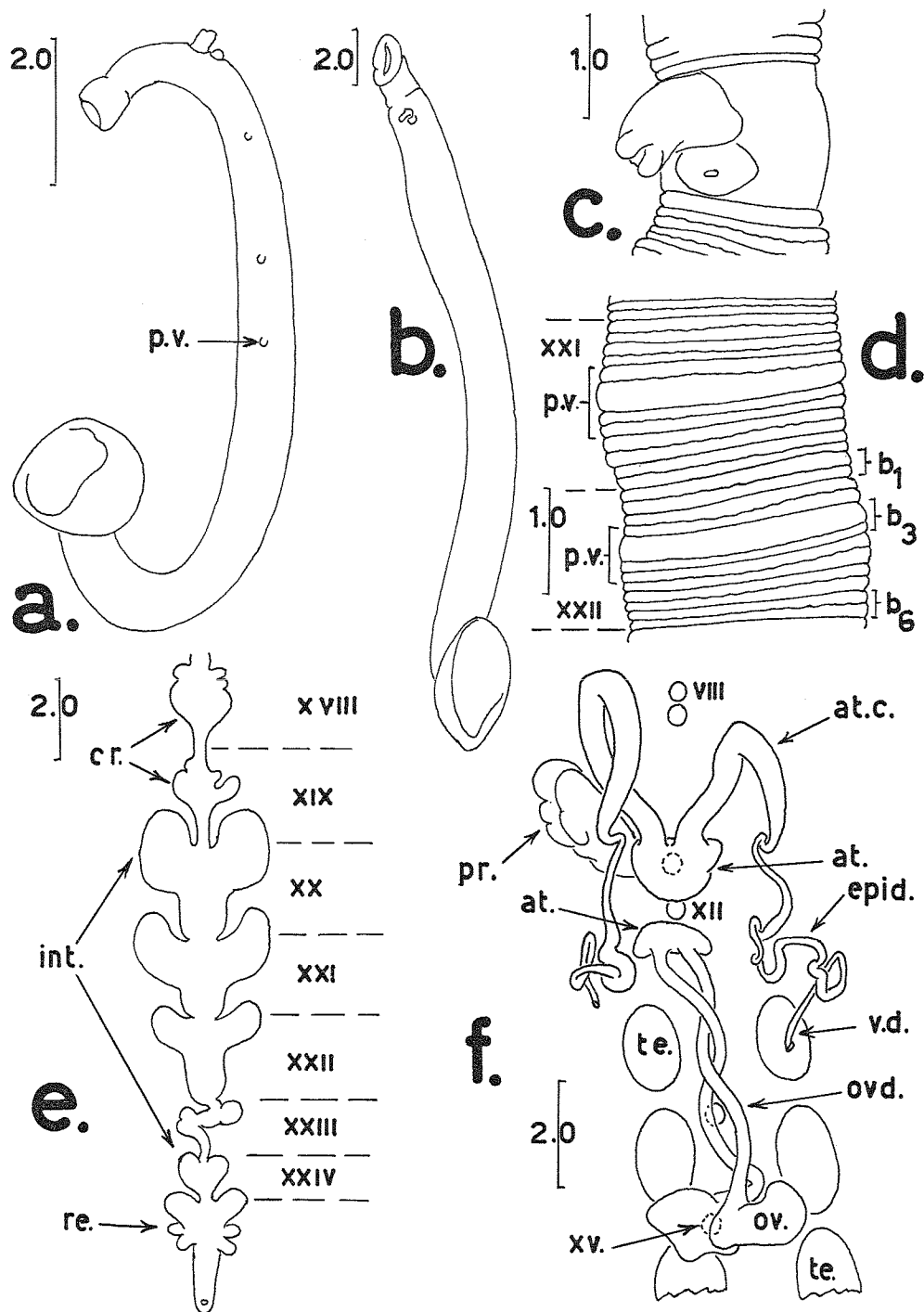


Fig. 1. *Bdellamaris eptatreti* Richardson, 1953; scales in mm; a, right lateral aspect of the 12.5 mm specimen (St. 616); b, ventral aspect of 25.1 mm specimen (St. 626) drawn to a similar size to show relative proportions of suckers, body regions, etc.; c, ventral view of 22.0 mm specimen (St. 616) showing male and female everts, obliteration of annulation, etc.; d, semidiagrammatic representation of the annulation on the dorsal aspect of somites XXI and XXII, 22.0 mm specimen (St. 616); e, crop compartments in somites XVIII and XIX, intestine, XX to XXIII, and rectum, 31.0 mm specimen (St. 626); f, anterior region of male paired ducts, male median region, and female reproductive system, all shown from the dorsal aspect, 31.0 mm specimen (St. 626).

Somites and somital ganglia indicated by Roman numbers; annuli, "b<sub>2</sub>", etc.; intersomital levels, broken lines; "c" category interannular grooves, undulating lines; at., atrium; at. c., atrial cornu; cr., crop; epid., epididymis; int., intestine; ov., ovary; ovd., oviduct; pr., pars prostatica; p.v., pulsatile vesicle; re., rectum; te., testis; v.d., vas deferens.

cimen are those of *B. eptatrei*. The only external items in question are the relationship of the gonopores and the annulation of the anterior region of the body. The latter is largely obliterated by pressure and torsion. There are both male and female everts; the male, flattened against the body, the height and width no more than one quarter of the width of the body at this level, and the evert relatively small, truncate, cylindrical; the female evert posterior to and close to the base of the male evert, a low convex mound, with the female pore, central.

The anterior sucker is small, 2.0 mm wide, deep cupped, lacking eye spots and interannular grooves, sharply set off from the short (4.0 mm) closely annulated trachelosome; the urosome, weakly separated from the anterior region, elongate (22.0 mm with a width of 4.8 mm), depressed (depth 2.0 mm); the somites 12-annulate with the "b" category interannular grooves more strongly defined than the "c" category and many "c" category annuli appearing as couplets; two postanal annuli; pulsatile vesicles detectable on 11 somites XIII through XXIII; posterior sucker, moderately contracted, shallow cupped, 6.0 mm wide, exceeding the maximum width of the urosome as also the length of the trachelosome.

The ventral body wall is thin from XIII through XIX; six pairs of elongate oval testes, fully visible, the anterior pair smaller than the others; large gland cells obvious along the margins as a thick internal layer along the greater part of the length of the posterior region of the body, and as smaller numbers partially obscuring the ventral nerve cord and somital ganglia.

Pharynx, very narrow, elongate, cylindrical, terminating at VIII/IX; wall of the crop extremely thin, transparent; the crop tubular along the anterior portion of the body and without recognizable compartmentation back to XIII/XIV, slightly and simply expanded in XIV, XV, and XVI, then with reduced irregularly lobed compartments with a primary median pair and various secondary lobes in XVII, XVIII, and XIX; the compartment in XIX joining terminally to the intestine; no postcaeca.

The wall of the intestine is translucent, lined with a longitudinally rugose epithelium; the intestine, compartmented, each compartment in XX, XXI and XXII, with a pair of large, lateral, anteriorly directed lobes on the anterior part of the compartment and the posterior half, simple, tubular, tapering to the next compartment; in XXIII, a reduced, narrowly tubular, asymmetric compartment which

has a small caecum on the right, extends very briefly transversely with a small anterior and a small lateral caecum, then ends as a short longitudinal tubular portion joining terminally to a small symmetrical lobed first compartment of the rectum, behind which the rectum is broadly tubular, thin walled with three pairs of lateral pouches (Fig. 1e).

The reproductive system (Fig. 1f) as seen in dissection agrees well with the original account excepting for the seminal vesicles. These were described as small, each an expansion of the vas deferens at XIII/XII posterior to and continuous with the loosely coiled epididymis in XII. Nothing with the nature of vesicles in this position is recognizable in the present specimen.

The six pairs of testes are elongate, ovoid, some compressed and appearing lobed, the anterior pair distinctly smaller than the posterior pairs which are similar in size, the testes situated at XIX/XVIII to XIV/XIII; vasa efferentia, not detectable in dissection, nor the vas deferens behind XIII, but in XIII, the vas deferens is dorsal to the testis; the epididymis, distinctly wider than the vas deferens, very slightly convoluted and loosely folded in XIII and XII, narrowing in the posterior half of XI to join terminally to the posterior end of the atrial cornu; right and left cornua commence at the same level; the cornua, elongate, cylindrical, each folded vertically as a dorsal procurrent and ventral recurrent limbs, the left cornu reflected in VIII, the right in IX; the recurrent limbs joining independently to the anterolateral aspect of the large inverted obtusely conical atrium which stands well above the body wall at XI/XII.

Ovaries, large, situated in XV, crowded beneath the crop and between the 2nd and 3rd pairs of testes; saccular, the wall, thin, transparent, and the whole compressed and appearing lobed; each ovary reducing at XIV/XV into the widely tubular, thin walled, transparent oviduct; the two oviducts spiral lengthwise in their path to the thin walled female atrium which also stands well above the body wall with a prominent lobe on each dorsolateral aspect.

The pars prostatica is pale brownish, opaque, minutely granular (possibly vesicular), in the form of independent large right and left lobed masses, each mass extending along the lateral face of the folded cornu, but not adherent to it, attached posteriorly to the dorsolateral aspect of the atrium.

There is no indication of albumin glands.

The two specimens 25.1 mm and 34.5 mm, tube (a), St. 626, have the thin ventral body wall

insunken, collapsed, and may possibly have been preserved under light pressure since the posterior suckers are flattened, disc-like, the anterior sucker of one turned sidewise and strongly compressed.

They are recognizably *B. eptatrei* in general form, as also in: the absence of eye-spots and interannular grooves on the dorsum of the deeply cupped anterior sucker; the crowded annulation on the posterior region of the body where some somites can be determined as 12-annulate; the pulsatile vesicles, some as sunken pits, detectable on 11 somites in the 34.5 mm specimen, but only on 10 somites in the 25.1 specimen which has none detectable on somite XIII; the thin ventral body wall; the testes, detectable at six intersomital levels; a male evert present in both, subcylindrical, sturdy, short, truncate; no female evert, the female genital aperture a thick-lipped wide transverse slit immediately posterior to the base of the male evert.

The posterior suckers in the two specimens differ strongly in relative proportions.

In the 25.1 mm specimen, the diameter (4.0 mm) of the posterior sucker is very little wider than the maximum width (3.8 mm) of the urosome; but distinctly greater than the length (2.9 mm) of the trachelosome (Fig. 1 b).

By contrast, in the 34.5 mm specimen, the flattened posterior sucker is broadly oval, 6.0 mm wide and 8.0 mm long, both dimensions considerably exceeding the maximum width (4.0 mm) of the urosome; and both much greater than the length of the trachelosome.

Flattened to a thin disc, the anterior margin of the posterior sucker in this specimen lies across the middle level in XXIII, i.e. at the level of the last pair of pulsatile vesicles.

The 22.0 mm specimen, St. 616, has a large prominent male evert, as long (1.0 mm) as the depth of the body at this level; stoutly cylindrical (0.6 mm wide), bluntly truncate, with a wide, thick-lipped transverse terminal aperture (Fig. 1 c). Immediately posterior to this is the low mounded, obtusely conical female evert which is about as long (0.4 mm) as wide (0.5 mm), and carries a minute circular terminal aperture. The two everts are relatively much larger than those in longer specimens.

Otherwise, the 22.0 mm specimen is recognizable externally as *B. eptatrei*: the deeply cupped small anterior sucker, smooth on the dorsum, lacking eye spots and interannular grooves, sharply set off from the short subcylindrical (1.4 mm wide, 1.0 mm deep) trachelosome which is closely and complexly

annulate; the urosome, elongate, depressed (2.5 mm wide, 1.5 mm deep), with obtusely rounded margins, very slightly shouldered on XIII; a 1st pair of pulsatile vesicles detectable on XIII, only 9 pairs detectable behind this, but the last pair is on XXIII; some somites (Fig. 1 d) recognizably 12-annulate, the "b" category grooves more strongly pronounced than the "c" category grooves so that distinct couplets are obvious along most somites; the posterior sucker, deeply cupped, 3.3 mm wide, distinctly wider than the maximum width of the urosome, and this dimension exceeding the length of the trachelosome.

The ventral body wall is thin on the urosome of the body; 6 pairs of elongate ovoidal testes are visible, the anterior the smallest; and the layer of large gland cells is visible at the margins.

By contrast with the above, the 12.5 mm specimen (Fig. 1 a) has no particular definitive resemblance externally to *B. eptatrei* excepting the absence of eye spots and interannular grooves on the dorsum of the anterior sucker, and the form of the everts.

The body is essentially elongate subcylindroid, nowhere distinctly depressed, subcircular in section, the maximum width 1.3 mm and the depth 0.9 mm; the two regions confluent.

The suckers are distinct from the body; both relatively large; the anterior 0.8 mm in diameter; the posterior, deeply cupped, 1.8 mm in diameter which greatly exceeds the length of the trachelosome as also the width of the urosome; a large male evert, 0.4 mm long by 0.3 mm wide, circular in section, truncate; the female evert, rounded, mound-like, 0.1 mm long by 0.3 mm wide, with a minute central terminal pore.

Annulation, close, complex, commonly incomplete, and lacking in some areas; obvious couplets and some triplets; some few pulsatile vesicles indicated by shallow sunken pits; the typical annulation of fully formed posterior somites cannot be determined with confidence nor the full number and somital range of the vesicles.

#### *Galatheabdella* n. gen.

Elongate, cylindrical, smooth, lacking branchia, flanges, tubercles, eye patches, oculiform spots, dark pigment, pattern, and lateral longitudinal vessels external to the muscular envelope; divided distinctly into trachelosome and urosome but without prominent shoulders or prepuce; trachelosome

terminating in a short, firm walled genital region; closely annulate everywhere; urosome with 11 pairs of external pulsatile vesicles, and 14-annulate fully formed somites; mouth pore, slightly postcentral; gonopores, narrowly separated; nephridiopores, not detectable; male evert, short, thin walled; crop, weakly or not compartmented; no postcaeca; intestine with somital pouches, all symmetrical; 6 pairs of saccular testes, in the posterior half of XIII through XVIII; epididymi, in tandem; no seminal vesicles; atrial cornua each formed on an anteriorly directed vertical loop; male atrium, simple, muscular, of moderate size; ovaries in tandem; oviducts, thin walled, elongate, join into a short, thin-walled, common oviduct terminating at the female pore; no female atrium; conductive tissue system, an obvious system, a band from each ovary extending to a conductive tissue organ located between the genital pores, fully distinct from but joined to the male atrium by a pair of narrow ventral connectives; clitellar gland cells, a massive system extending from XXVI through XIII, drained by columns of aggregated ducts opening ventrally in the genital region.

Derivation of generic name: Galathea, the name of the ship + bdella, a leech.

Following Soós's key (1965) to the genera of the Piscicolidae, the characteristics of the new genus associate it with *Bdellamaris*, the two being similar in having: a simple form; a smooth skin lacking tubercles and papillae; 11 pairs of external pulsatile vesicles; six pairs of testes; and no postcaeca.

In previous practice, most workers would have recognized two distinct genera on the difference in the level of somital annulation, supporting this by the marked difference in form. For the reasons set out by Soós in the introduction to his key, the intimate details of the morphology of the alimentary and reproductive systems generally cannot be employed for the separation of genera in this family. Such information is inadequate or lacking for many genera.

In this case, we have two genera similar in the details given above, similar also in an extensive development and arrangement of large clitellar gland cells, as also the aggregation of the ducts of these cells into thick columns terminating in the vicinity of the genital pores. They are similar also in the general morphology of the alimentary and reproductive systems; but they differ significantly in the detailed morphology of these systems.

*Galatheabdella* differs from *Bdellamaris* not only

in having 14-annulate somites, but also in having: a symmetrical unmodified terminal portion of the intestine in XXIII, and a simple tubular rectum; a well-formed reflected primary loop on the anterior region of the paired male duct; the atrial cornua folded each as a short anteriorly directed loop reflecting at X/XI, the procurent initial limb of the cornu distinctly shorter, about  $\frac{1}{2}$  of the length of the recurrent terminal limb; and an obvious conductive tissue system which has not been detected in *Bdellamaris*; no female atrium.

The contrasting details seen originally (RICHARDSON, 1953) in *Bdellamaris eptatrei* could be no more than described without evaluation and with no full confidence that such organs were truly stable in the form as seen. To find the display of these organs in the same form in the present material, leaves no doubt on their morphological stability. *Bdellamaris eptatrei* has an asymmetrical terminal portion on the intestine and a rectum commencing with a discrete compartment, continues as broadly lobed. The anterior region of the male paired duct is folded, not formed on a primary loop. The atrial cornua are formed on an anteriorly directed primary loop with equal limbs, reflected at VIII/IX.

Type species: *G. bruuni* n. sp. (by monotypy).

#### *Galatheabdella bruuni* n. sp.

(Figs 2, 3 a-c, 4 a-c)

The specific name is in honor of the late Anton F. Bruun, in recognition of his contributions to hirudinoLOGY.

#### Material:

St. 601, Tasman Sea (45°51'S, 164°32'E), 4400 m,<sup>1</sup> 14 Jan. 52, gear: herring otter trawl, bottom temp.: c. 1.1°C. – 7 specimens: 68 mm, 80 mm (dissected), 82 mm, 84 mm, 90 mm, 1 incomplete (minus region from first pulsatile vesicle anterior), and 1 sectioned (frontal, anterior end; transverse, posterior end).

St. 607, Tasman Sea (44°18'S, 166°46'E), 3880 m,<sup>1</sup> 17 Jan. 52, gear: herring otter trawl, bottom temp.: c. 1.1°C. – 1 specimen: 83 mm, fragile.

1. Dr. Wolff informs us that in the Station Journal, the following fish species larger than about 10 cm were collected at the two stations:

St. 601. Benthic: 6 species, 24 specimens

Meso-pelagic (about 3-1000 m): 6 species, 10 specimens.

St. 607. Benthic: 3 species, 8 specimens

Meso-pelagic: 4 species, 5 specimens.

Since benthic specimens are both the most numerous and

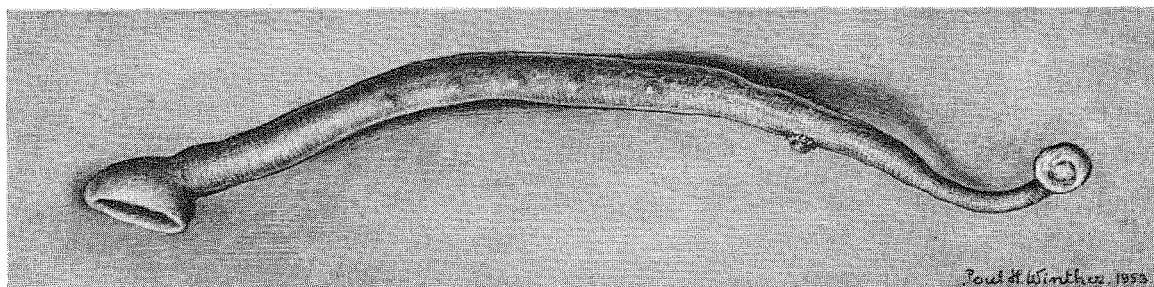


Fig. 2. *Galatheabdella bruuni* n. gen., n. sp. from St. 607.

The series taken at St. 601 is selected as the syntypes since a holotype description cannot be adequately taken from any one individual specimen.

Two of the specimens from St. 601, 68 mm and 84 mm, are unsuitable for general study. Although well extended, both are grossly irregular in form, the larger swollen erratically along the urosome at seven levels, dorsally at an eighth level. The smaller is irregularly constricted at four levels along the urosome. This specimen shows a long and large male evert which may possibly be abnormal in size. The annulation is essentially obliterated in these two specimens; but the smaller shows a distinct 1st pulsatile vesicle close behind the level of the division between trachelosome and urosome, a shallow open pit crossed by two annuli which appear as sharp dorsoventral ridges.

The extended anterior sucker of the 84 mm specimen has been preserved with the ventral surface directed dorsally. This is seen in some other specimens, and in one both suckers are preserved with the ventral surface directed dorsally.

#### General form (Figs 2, 3 a, b, c)

An essentially elongate cylindrical leech with relatively large narrowly attached suckers; the division into trachelosome and urosome, distinct, but without prepuce or prominent shoulders; the surface, finely and closely annulate, lacking papillae, obvious somital sense organs, or other ornamentation; abranchiate, with 11 pairs of large external pulsatile vesicles; no dark pigment, pattern, eye

generally the largest of the fishes taken at the two stations it may be assumed that the leeches originate from a benthic species. If so, the most probable would be *Coryphaenoides* sp. of which St. 601 yielded 19 large specimens and St. 607 6 large specimens.

In support of a benthic origin of *Galatheabdella bruuni* it should be noted that the succeeding leech species was collected at St. 716 (cf. WOLFF, 1961) at a depth of 3570 m; the host was identified as *Bassozetus* sp. (Brotulidae) which is benthic.

spots or oculiform patches; dusky white excepting where underlying pinkish individual large cells show through the thin transparent body wall.

The trachelosome increases in width from the sucker back to the urosome; it is divided into a longer anterior thin-walled finely annulate portion, and a short posterior thick-walled almost smooth "genital region" which includes the gonopores.

The urosome is uniform in width and depth along its greater length; finely annulate everywhere; the 1st pair of vesicles essentially at the anterior end of the urosome; the 11th pair posterior, followed by a short portion of the urosome which reduces in both diameters to provide the base for the posterior sucker.

The anterior and posterior suckers, both thin, discoid, attached subcentrally; the anterior wider than the urosome; the posterior, slightly longer than the trachelosome, and about twice the width of the urosome.

A specimen, 80 mm long, shows a typical form. In this, the anterior sucker is 5.5 mm wide, 5.0 mm long; the anterior end of the trachelosome is attached slightly postcentrally on the sucker, is narrow, 2.0 mm anteriorly, increasing only slightly to 2.5 mm along the greater part of its length, with the depth quite uniformly 2.0 mm, and of these dimensions at the level of the gonopores 15.0 mm from the anterior edge of the sucker; the trachelosome terminates at 16.0 mm; the urosome increases to a width and depth of 4.5 mm at 22.0 mm, and continues with these dimensions to 60.0 mm, reducing about equally in both dimensions to be 3.0 mm wide and deep at 70.0 mm, the level of the anus, and the basis of the posterior sucker which is 10.0 mm wide and long. The full series of pulsatile vesicles cannot be detected; the most anterior detectable vesicles are at 23.5 mm, 7.0 mm posterior to the division between trachelosome and urosome; the following vesicles are spaced at intervals of about 6.0 mm.



In the 90 mm specimen, the 1st detectable vesicles are at 13.0 mm; the following vesicles spaced at intervals of 6.0 mm, and the last vesicles, the 11th pair are at 75.0 mm, i.e. slightly less, 5.5 mm, from the base of the sucker and this distance less than half of the diameter, 12.0 mm, of this sucker.

#### Annulation (Fig. 3c)

The specimens are extended to such a degree that none show a complete annulation. Interannular furrows are shallow, weakly defined, many faint, erratically indicated, broken, partly or entirely obliterated in various areas.

There appear to be both primary and secondary furrows; the primaries defining annuli are more or less separated by the secondaries, which may be as deep as the primaries in some aspects, weaker or absent in others, so that annuli often appear as couplets or triplets with the components equivalent in length, or not, and without repetition in sequence in adjacent somites. In this way, areas in which the furrows are more distinct appear to be very closely annulated.

There are no furrows recognizable as intersomital. There are no somital papillae, somital or other repetitive sense organs, detectable nephridiopores, pigment patches, regular annuli of distinctive length, or other external guides to the somital annulation excepting the pulsatile vesicles on the urosome. There are no such vesicles on the trachelosome. Although the body wall is thin, transparent, neither testes nor the ganglia of the ventral nerve cord are visible. There are minute dermal sense organs appearing as white points, but these are erratic and not detectable as transverse or longitudinal series.

The following description is assembled from several specimens.

The dorsal aspect of the anterior sucker is completely smooth, lacking eye-patches and oculiform spots, and attached postcentrally to the narrow anterior end of the trachelosome.

Studied under oblique light shining longitudinally along the region, the trachelosome of the 81 mm specimen shows 32 annuli which can be recognized as primary, on the right side between the anterior sucker and the 1st pulsatile vesicle. The annulation on the left side is weak and often indistinct, so that few annuli can be followed from the right side to the left, and there can be no confidence in this number as the true total.

The first eight annuli are narrow and of much the same length. There is a gradual increase in length in

the next six annuli. The trachelosome increases in width behind these, and with this there is a gradual progressive reduction in the length of the annuli back to the 24th annulus which marks the anterior end of the genital region of the trachelosome.

There are six or possibly seven annuli in the genital region. These are elongate, separated by very indistinct furrows, and so poorly defined that the region appears smooth.

In the above count, the male pore appears to be located in or very close to the furrow separating the 26th and 27th annuli; the female pore, anterior in the 30th annulus, close to the furrow 29/30.

The 31st and 32nd annuli are more strongly defined than those of the genital region, and possibly both, and certainly the 32nd, belong to the urosome, are immediately anterior to the pulsatile vesicle, and accordingly the anterior half of the 1st somite of the urosome is greatly reduced in length.

The urosome of the incomplete specimen has not been extremely extended, the interannular grooves are deeper, and the annuli more clearly defined along the posterior half where the last seven pulsatile vesicles can be seen on the right side.

In this, the annuli appear shorter and more numerous along the dorsum than on the venter. In lateral view, many annuli as seen on the venter, are individually subdivided on the dorsum by a distinct furrow not recognizably differing from the furrows along the venter excepting that they do not reach to the venter. They weaken and mostly terminate on the lateral aspect. These can be termed secondary or incomplete furrows. There is nothing recognizable as somitally repetitive in the occurrence of the secondary furrows.

The total number of annuli in the fully formed urosomal somite as given below, includes only the primary, i.e. complete annuli.

Each pulsatile vesicle is crossed by two interannular grooves which reach to the venter, and each vesicle is accordingly enclosed in three annuli which form a distinct triplet, and the site of a vesicle is often detectable by a local thickening of these annuli when the vesicle is fully contracted.

There are 11 complete annuli between these triplets, giving a total of 14 such annuli in the fully formed urosomal somite. Some 16 are countable as such in a few somites where a "secondary" furrow extends to the venter; but such "secondary" furrows are not repetitive from somite to somite.

(In the specimen from St. 607 the annulation is quite distinct on some of the fully formed somites



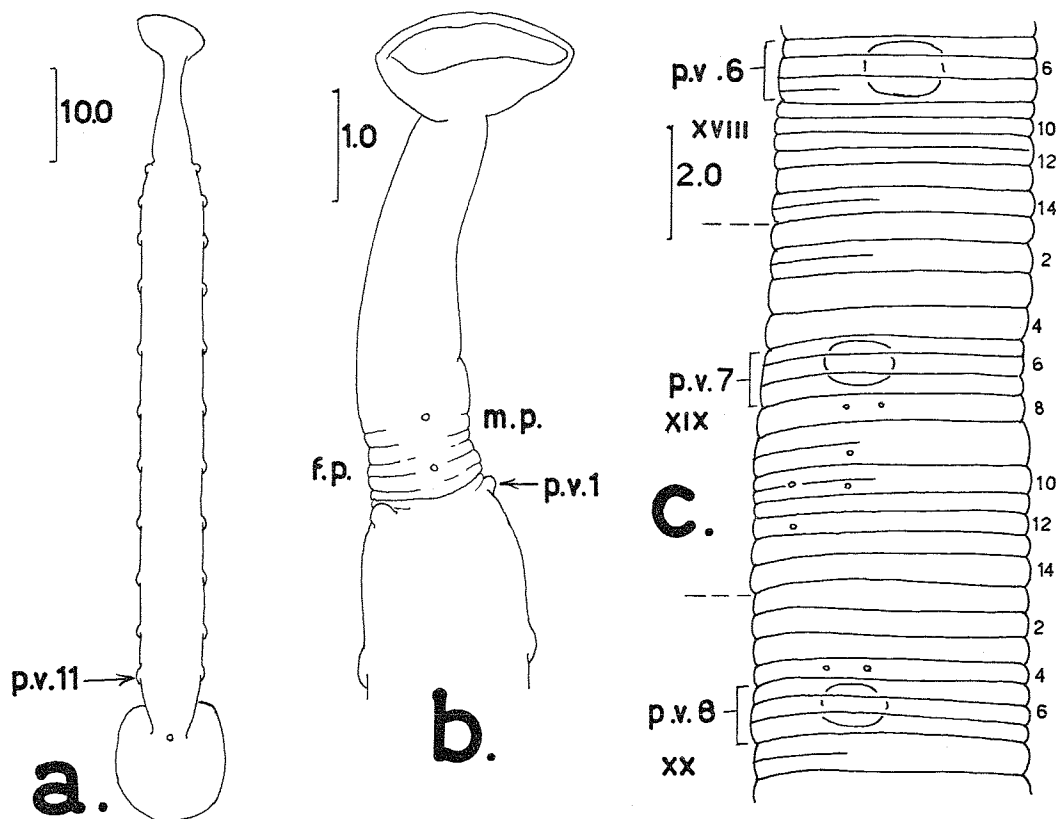


Fig. 3. *Galatheabdella bruuni* n. gen., n. sp. The figures are based on the type series from St. 601; scales in mm; a, dorsal aspect of 90 mm specimen; b, ventral view of trachelosome and anterior end of urosome of 90 mm specimen; c, right lateral aspect, somites XVIII through to XX, showing annulation of the fully formed urosomal somites of the urosome of the incomplete specimen.

f. p., female pore; m. p., male pore; p. v., external pulsatile vesicle.

of the urosome. The annuli are essentially equal in length. These somites show a total of 14 annuli in the somites of the urosome, and fully confirm the assessment made from the above specimen in the type series).

Counting the annulus behind the triplet of the last pulsatile vesicle, as being the 1st, there are 19 well defined annuli between this vesicle and the anus. All are complete across the venter. Of the 19 in this series, the first 12 show secondary furrowing on the lateral aspect, and these constitute a first group. Behind this group, some show a secondary furrow extending partly onto the dorsum, and following these some are divided across the dorsum; but all such show as distinct couplets and each is counted above only as a single annulus. Secondary furrowing is stronger on the venter behind the first group, with many furrows crossing the venter, so that there are 30 annuli countable on the venter between the last pulsatile vesicle back to and including the preanal annulus.

There is a single well-defined postanal annulus

which is complete on all aspects. A second postanal annulus extends across the venter onto the lateral aspect of the base of the sucker, but is not defined on the dorsal aspect.

The dorsum of the sucker is essentially smooth; the margin, simple; the venter, richly and fully covered with minute, contiguous, low, flat-surfaced, crowded papillae.

#### Body wall and musculature

The body wall is extremely thin, delicate, translucent, faintly white; when divided and reflected, the musculature of the body wall is recognizable in narrowly spaced, thin, longitudinal bands of lengthwise strands; the bands, about 0.3 mm wide, are spaced about the same distance apart, and individual bands can be readily followed through many somites.

Dorsoventral musculature is very sparse, to be seen as spaced, delicate strands, three or less to the millimeter, and nowhere recognizable as well formed palisades.

Well-defined groups of strands of muscle in the genital region have their origin on the ventral body wall, and extend to insertion, one group onto the ventral aspect of the atrial cornu; the other group, onto a papilla close to the base of the male atrium. The groups are present on each side. These appear to be well-defined retractor muscles for the retraction of the male evert.

#### Body cavity

Excepting anterior to the genital region of the trachelosome, the body cavity is packed with closely crowded large subspherical to subovoidal gland cells, in the order of 0.3 mm to 0.5 mm in diameter, varying in shape due to compression. The colour of the smaller cells ranges from pale pink to brown, with some few white which is the colour of the larger cells.

These form a dense, thick mass extending from the body wall deep into the body cavity, filling it so completely as to obliterate any sign of the secondary body cavity excepting along the ventral midline where there is a narrow longitudinal channel filled with coagulated coelomic fluid.

The crop and other organs are completely concealed within this mass which gives no indications of being divided into groups, clusters, or other definable masses.

These cells are similar to the cells recognized as clitellar gland cells in *Bdellamaris eptatrete*. In that species, columns of aggregated ducts draining these cells are recognizable well back in the urosome, and can be traced anteriorly to their termination on the ventral aspect of the body wall in the region of the gonopores. In this leech, the columns of aggregated ducts can be recognized only in the vicinity of the gonopores.

#### Central nervous system

The anterior ganglionic mass is of the short form typical in leeches where this is formed of the neuromeric components of six somites.

The 1st independent ganglion of the ventral nerve cord is accordingly the ganglion of VII, close to and separated by only 0.5 mm from the posterior end of the ventral ganglionic mass; VII to VIII, 1.5 mm; VIII to IX, and IX to X, both 2.5 mm; X to XI, 1.5 mm, X fully ventral in position, XI raised slightly from the ventral surface and situated about half way along the atrial cornua.

The nerve cord then arches high over the male atrium, with XII just posterior to the dorsal aspect

of the atrium; XI to XII, 2.5 mm; XII to XIII, 4.0 mm; XIII to XIV, 5.0 mm. Ganglion XIII and the following ganglia are fully ventral, close to the body wall.

Externally, the pulsatile vesicle of XIII is separated from the base of the trachelosome by only one or two short annuli, and as the vesicle is essentially central in the length in following somites, it is clear that the prevesicular half of the body wall of somite XIII is greatly abbreviated.

Internally, as can be assessed from the above measurements, the distance separating ganglion XII from ganglion XIII is essentially of the same order as the distance from ganglion XIII to ganglion XIV.

Comparing the level of the pulsatile vesicle in XIII with the level of the ganglion, it is seen that the ganglion is about 1.5 mm posterior to the level of the pulsatile vesicle. The ganglion is not morphologically median in the length of the somite, but is situated posteriorly at about the midpoint in the length of the posterior half of the somite.

In the somites behind XIII, the somital ganglion is close to the midpoint in the length of the somite, and the pulsatile vesicles at about this same level.

#### Alimentary tract (Fig. 4a)

The mouth is a small opening, subcentral, slightly posterior to the centre of the anterior sucker. None of the specimens show an extended proboscis.

The proboscis is muscular, narrowly cylindrical, freely movable through the anterior ganglionic mass, uniform in diameter, and terminates in the middle of IX where three or four short cords of gland cells, each a linear arrangement of cells as a single row, join to the base of the proboscis. The cords of gland cells extend anteriorly alongside the proboscis.

The wall of the crop is very thin, transparent, and smooth internally. The crop is narrowly tubular, without distinct compartmentation, and lacking detectable sphincters. It is compressed along its length by the mass of clitellar gland cells; and the narrowly tubular form may not be fully typical.

The crop ends in a weak small sphincter at the level of the ventral nerve cord ganglion in XIX, and joins terminally to the intestine at this level.

The wall of the intestine is thicker, semi-transparent, and lined with a thick epithelium which is thrown into prominent spaced longitudinal rugae.

The intestine is incompletely compartmented in XX through XXIII. Each compartment is of the

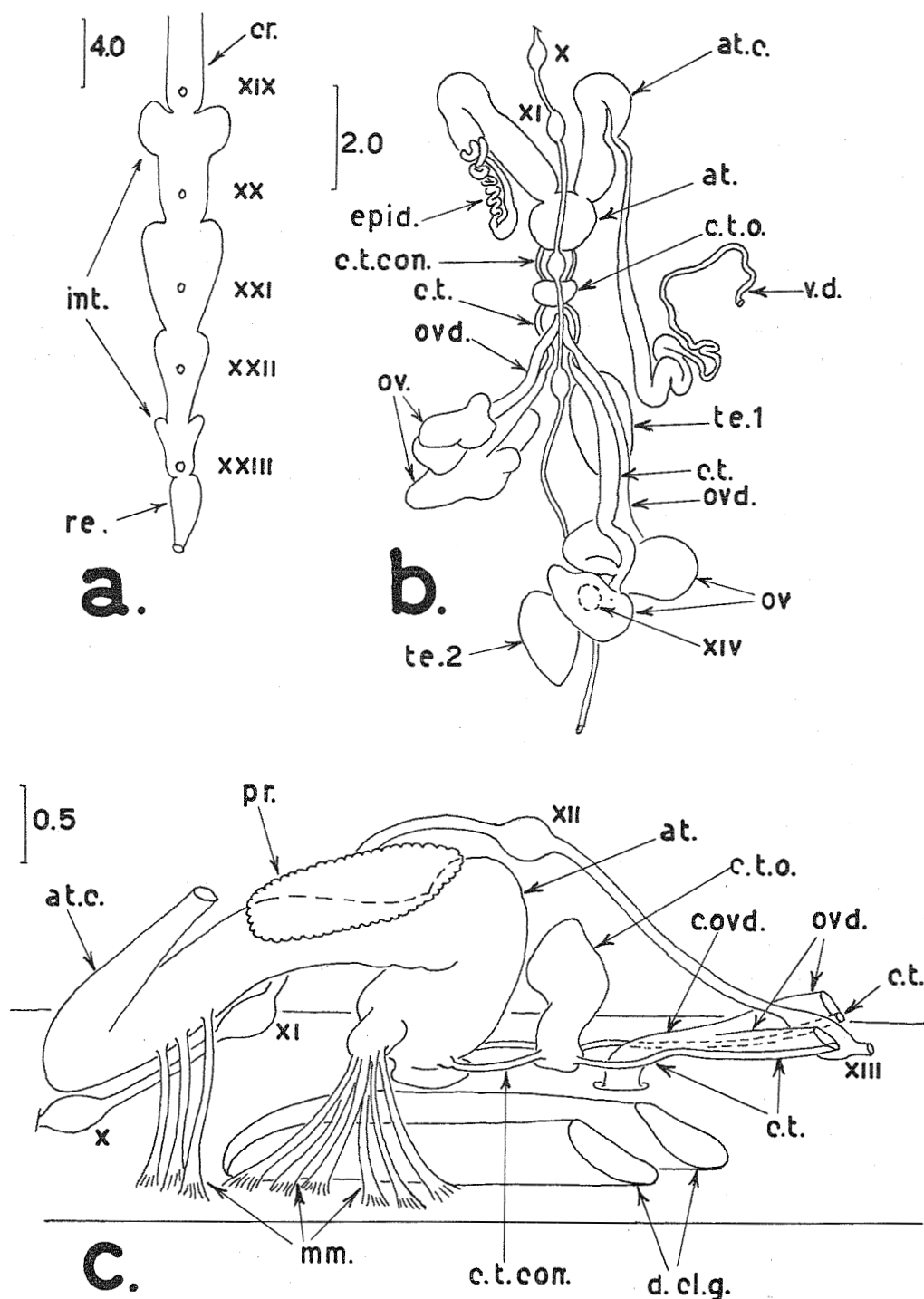


Fig. 4. *Galatheabdella bruuni* n. gen., n. sp. The figures are based on the dissection of the 80 mm specimen from the type series, St. 601; scales in mm; a, crop in somite XIX, intestine, rectum; b, anterior portion of male paired ducts, male median region, female reproductive system, conductive tissue system, as seen from the dorsal aspect with the anterior ovary displaced laterally, and the medial aspects of both ovaries shown; c, anterior portion of male and female reproductive systems, the conductive tissue system, from the left lateral aspect to show the relationship of the conductive tissue system, etc. at., atrium; at. c., atrial cornu; c. cr., crop; c. t., conductive tissue; c. t. con., conductive tissue connective; c. t. o., conductive tissue organ; d. cl. g., anterior end of left columns of aggregated ducts draining the clitellar gland cells; epid., epididymis; int., intestine; mm., retractor muscle strands; ov., ovary; ovd., oviduct; pr., prostate; re., rectum; te., testis; v. d., vas deferens.

length of a somite, expanded in the anterior half as a pair of large lateral pouches, more narrowly tubular behind this, and only slightly reduced in width before joining the following compartment. There are no sphincters or valves between these compartments. The major longitudinal rugae are continuous from compartment to compartment.

The intestine connects terminally to the rectum at XXIII/XXIV. The wall of the rectum is thick, opaque, and the rectum uniformly tubular along the greater part of its length, reducing slightly in diameter before ending at the anus.

#### Reproductive system (Fig. 4b-c)

Due to the condensation of the somites in XI, XII and the anterior half of XIII, the precise definition of the morphological relationships of the gonopores cannot be determined. The male pore is closer to the level of ganglion XII than to the level of ganglion XI, and it would seem this pore is probably anterior in XII; and from this, the female pore is probably posterior in XII.

The firmness and thickness of the body wall in X through XII is due to thick columns of aggregated ducts draining the clitellar gland cells. On each side of the ventral body wall there are two main columns which are contiguous. The right and left pairs are spaced apart, leaving a median area of thin body wall to which the terminal reproductive structures are attached.

The testes are saccular, elongate ovoid, each about 30 mm long, close to the midline and completely covered on the dorsal and lateral aspects by clitellar gland cells, so that the testes are difficult to detect.

There are six pairs; the most posterior pair in XVIII; the most anterior pair in XIII. The posterior pairs are situated adjacent to the ventral nerve cord ganglion; the anterior pairs, located in the posterior half of the somite; those in XIV and XIII, crowded beneath the ovaries. None are intersomital.

Vasa efferentia could not be detected. The vasa deferentia could be recognized at about the level of ganglion XII where they emerge from the mass of clitellar gland cells, and arch over the anterior end of the columns of ducts draining these cells.

The anterior portions of the paired male ducts are asymmetrical, arranged in tandem, the right posterior to the left, and both in the mid-line above the terminal structures of the reproductive systems.

The left duct extends anteriorly from the level of ganglion XII, becoming white, opalescent as a nar-

rowly tubular epididymis which is loosely convoluted, extends to the level of ganglion XI, and then forms a posteriorly directed primary loop reflecting just anterior to ganglion XII, with the initial recurrent limb much folded on itself, tortuous and distinctly narrower than the procurrent limb which is less tortuous and reduces to enter abruptly into the posterior end of the atrial cornu.

The right vas deferens forms a posteriorly directed loop at the level of ganglion XII; the loop reflecting at the level of ganglion XIII; the initial recurrent limb, opalescent, narrowly tubular, slightly convoluted on the anterior half of the limb, the posterior half of the limb increasing in width and folded on itself; the procurrent limb, also opalescent, almost straight, diminishing gradually in diameter in the 1st half of the limb to become narrowly tubular before joining abruptly to the atrial cornu.

The tandem arrangement and the differing form of the primary loops are related to development in the restricted space beneath the mass of clitellar gland cells.

The atrial cornua are essentially symmetrical; both formed on an anteriorly directed primary loop in the vertical plane, reflecting at the level of ganglion X; the initial procurrent limb, dorsal, short, slightly less than half of the length of and narrower in diameter for most of its length than the recurrent limb. The recurrent limb is ventral; the two cornua join independently to the anterolateral aspects of the dorsal portion of the atrium.

The male atrium is an inverted, obtusely conical, firm walled sac with a distinct layer of external vertical muscle strands. A firm lateral papilla extends from the lower region of the atrium on each side. Transverse horizontal muscular strands having their origin on the ventral body wall, extend across the dorsal surface of the columns of aggregated clitellar gland ducts, and are inserted onto the papilla, forming an obvious muscular system extrinsic to the atrium, and suitably arranged for retraction of the extended male evert organ.

The female system exhibits asymmetry. The ovaries are large, deeply lobed thin-walled sacs, situated along the midline, crowded amongst the masses of clitellar gland cells, and arranged in tandem, with the right ovary in the anterior half of XIV, the left in the posterior half of XIII.

When turned to the side, each ovary appears to be connected to a large white female atrium, by a compressed, opaque, white band, which is firm and richly fibrous to the point of the needle, narrow

near the female atrium, widening gradually back to the ovary where it divides briefly, sending a short band into the proximal part of each lobe of the ovary.

Extending along the dorsal aspect of each band, there is a very thin-walled, soft, pale brownish tissue which appears to invest the white band, and has much of the appearance of the albumin glands seen investing the common oviduct in hirudiniform leeches.

When traced anteriorly, the brownish tissue proves to be the oviducts, with the right and left oviducts joining below the ventral nerve cord immediately anterior to ganglion XIII, to form a very short thin-walled common oviduct which terminates at the gonopore without any indication of a distinct or functional female atrium.

Between the female pore and the male atrium, the obvious, median, pale white, soft, fibrous, vertical, obtusely cylindrical body is about 0.5 mm tall. At first sight, this appears to be a female atrium; but it is not thin-walled and lacks a central chamber. This organ is attached by a soft, pale tissue to the ventral body wall between the gonopores. The body of this organ is in contact with, but separates readily from the male atrium.

The fibrous white bands associated with the oviducts narrow progressively anteriorly, each diverging as a very narrow, firm, white fibrous cord extending lateral to the end of the common oviduct, and each joins independently into the posterior aspect of the base of the fibrous organ.

A pair of similar, but slightly firmer and better defined cords continue as connectives from the anterior aspect of the base of the fibrous organ and enter the base of the male atrium.

This system of white fibrous structures corresponds morphologically to the conductive tissue system first described by BRUMPT (1901: 70; figs. 7 and 8). It is generally similar to BRUMPT's "group 4," in which he placed *Calliobdella lophii* van Beneden & Hesse, 1863, *C. nodulifera* (Malm, 1863), and *Cystobranchnus mammillatus* (Malm, 1863). In each of these species, narrow conductive tissue connectives pass directly from the male atrium to the ovaries. There is no individual mass of conductive tissue standing between the male atrium and the

female gonopore; at least none is described or shown as such in the figures.

Thus *Galatheabdella bruuni*, which resembles *Calliobdella lophii*, *C. nodulifera*, and *Cystobranchnus mammillatus* in possessing conductive tissue connectives, joining the male atrium with the ovaries, differs from these species in possessing a median conductive tissue organ standing separately between the male and female gonopores.

The absence of postcaeca in *G. bruuni* also separates it from the three above species, which possess a postcaecum with fenestrae. Postcaeca are also absent in *Bdellamaris eptatreti*, the other species in the collection, *Pterobdella amara* Kaburaki, 1921, *Pterobdellina jenseni* Bennike & Bruun, 1939, *Phyllobdella maculata* Moore, 1939, and *Trulliobdella capitis* Brinkmann, 1947.

#### PISCICOLIDAE gen. et sp. indet.

##### Material:

St. 716, East Pacific off Costa Rica (9°23'N, 89°32'W), 3570 m, 6 May 1952, gear: herring otter trawl, bottom temp.: c. 1.9°C. – 1 specimen, total length 7.75 mm; maximum width 0.5 mm. From *Bassozetus* sp.

The anterior sucker, thin, fully expanded and the margins curled posteriorly so that the diameter can be only estimated as about 0.6 mm; the mouth pore, central; the everted thick proboscis, 0.6 mm long; the base to the anterior sucker, 0.25 mm wide.

The body elongate cylindrical; of the maximum diameter along the middle of its length and tapering posteriorly to be 0.4 mm wide at the base for the posterior sucker which is thin, explanate, and about 1.0 mm in diameter.

The surface of the body appears eroded.

Annulation, papillae, vesicles, tentacles, branchiae, and the genital pores, are not detectable.

The specimen is most delicate; the body wall, thin, soft, broken in several areas, exposing large clitellar gland cells anteriorly; but no other internal structures can be observed.

Any manipulation is damaging without providing useful information.

## SUMMARY

Change in form over a length range of 12.5 mm to 34.5 mm is described for *Bdellamaris eptatreti* taken in Milford Sound at depths of 290 to 610 m. *Gala-theabdella bruuni* n. gen., n. sp. described from specimens taken in the Tasman Sea off the west coast of the South Island in hauls from 3830 to 4400 m. The new genus resembles *Bdellamaris*, differing in

having 14-annulate somites, a symmetrical unmodified intestinal compartment in XIII, a simple tubular rectum, a well-formed conductive tissue system, etc. A specimen from 3570 m in the East Pacific (deepest known record of a fish leech) could be identified only to family.

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## ADDENDA

(1) After this paper had been brought to page form, one of us received specimens referable to the piscicolid *Austrobdella translucens* Badham, 1916. BADHAM closely details the remarkable change in form with growth in this species which is flattened to be leaf-like after a metamorphosis.

Specimens 1.5 mm long, have a tapering cylindrical body with continuous regions, the depth equal to the width, and the posterior sucker nearly 1.5 times the width of the body. The animal continues much of this form up to a length of 5.5 mm, then metamorphoses so that when 7.5 mm long, the regions are distinct; the trachelosome, sub-cylindrical; the urosome depressed and widened with the depth about  $\frac{1}{2}$  of the width, and the posterior sucker only  $\frac{2}{3}$  of the width of the urosome.

BADHAM found mature testes in specimens which were 4.0 mm long and cylindroid in form.

In this case, as also in *Bdellamaris eptatreti*, it can now be recognized that small immature and even male mature cylindroid piscicolid leeches with a large posterior sucker, cannot be described with any measure of confidence as exhibiting the form of the fully grown animal.

BADHAM, C., 1916: On an ichthyobdellid parasitic on the Australian sand whiting (*Sillago ciliata*). — Quart. J. Micr. Soc. (n. s.) 62: 1-41.

(2) There is a significant omission in the description of the male evert in *Bdellamaris eptatreti*. When this is fully extended, it contains the greater part of the length of the recurrent terminal limbs of the atrial cornua which end at the pore on the evert.